

Interactive comment on “High levels of reactive gaseous mercury observed at a high elevation research laboratory in the Rocky Mountains” by X. Faïn et al.

Anonymous Referee #2

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Overall this is a good paper and merits publication. The topic is scientifically relevant and the authors have done a good job of presenting the information in a clear and concise manner. I recommend that this paper is published with some revisions that take into account the comments given.

Comments: 1. The abstract/conclusion does say why these observations are different from the other high altitude stations for enhanced RGM concentrations. In 1 sentence, add in why these observations are different from others reported. 2. No clear picture of the major oxidant that transforms GEM is given yet it is concluded that the high RGM levels are a result of oxidation of tropospheric GEM. Please address 3. Page

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2: Introduction a. Maybe add in what the quartz filter cuts off in terms of size of the particles and that not all PHg is trapped. b. At times in Polar Regions GEM is not 95% of the total atmospheric mercury. Maybe include this comment into the text. c. Identify which global chemical models show divalent Hg species can dominate GEM in the upper troposphere. d. The point about “in situ” oxidation needs to be really clarified. My understanding of in situ is that it means “in the place” and thus when one refers to in situ reactions happening it means that they are occurring where the measurements are being collected. That is not the case in this paper and you are referring to the reactions occurring elsewhere and being transported to the site. Thus, this is not in situ. Please clarify in the text what you mean by in situ as you refer to this throughout the paper and it’s confusing to the reader. e. Perhaps you should mention that shortcomings of this type of measurements in the paper somewhere. I know that you say that RGM is operationally defined as what we trap on KCl denuders but maybe you should go a bit further to say (at some point) that we have no standards for RGM and thus we cannot expect that $RGM + PHg = GEM$ because the instruments are not calibrated necessarily to give us that information accurately. 4. Mercury measurements: a. Describe the inlet system. The reader may not know that the 1130/35 is a front end to the 2537 and that you are not collecting the species separately. b. Why is the flow of the 2537A set to 0.8 lpm as opposed to 1 as usually used? Is this because the pump can’t pull 1 lpm? If so, please mention why this differs than what is commonly used. Because there are no calibration systems then all differences should be addressed. c. Did you use soda lime? 5. Meteorological and chemical measurements: a. Why did you average the data on 2 hours and not 1 hour? You are only sampling Hg for 1 hour and then analysing for 1 hour. . . would it not make more sense to have the met data match the sampling period and not the sampling and analysis period? 6. Results and Discussion: a. Page 8 – Figure 2 does not show ozone as well as CO. b. Page 8 – if the number of aerosols increased can you comment on why the PHg concentrations did not? c. Figure 2 shows the RGM peaking in the afternoon – is that peak statistically significant? d. Figure 3 – Is there any relationship between PHg and aerosols and PHg and CO? e.

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Page 9 – Discussion here about the in situ measurements imply that the reactions are occurring at the Storm Peak Laboratory. Are your observations from in situ reactions or transported from other areas? f. Page 11 – because there is no correlation between RGM and ozone then this is indicative that it is not the same mechanism as what occurs in Polar Regions because that correlation is well defined. g. Page 11 - GEM depletions were not observed by Banic et al above 8km...I think. h. Page 11 – you suggest here that the GEOS-CHem model shows that RGM/PHg can dominate GEM but this is not shown at all in the data. The relationship between this comment and the data is unclear. i. Figure 5 – the plots are really small and challenging to read j. Page 12 - the BrO measurements measured by satellite are the whole column and do not show enrichment in the troposphere? I do not believe that they can distinguish. k. Page 12 – most data show that BrO oxidation of GEM occurs near the surface l. Page 12 - you mention that most of the enhanced RGM is deposited prior to arrival at the Storm Peak Laboratory – have you done a quick calculation of the deposition velocity of RGM (specifically HgCl₂) and the distance the air mass has travelled to see if the concentration measured at the site is logical? That would be a good exercise. m. Page 13 – you discuss the possibility of heterogeneous oxidation of GEM involving water droplets or snow crystals. Would you not see an increase in the PHg concentrations if there were some aerosols involved in this reaction? Language: 1. The “Rockies” is slang for the Rocky Mountains. One does not say Rockies Mountains 2. Page 2 – first sentence has mercury too many times and is a run on sentence. 3. Page 3 – sentence that starts “At a high elevation” must be rephrased. 4. Page 3- Dearth should be changed to “lack of”. Keep language simple. 5. Page 8 – sentence that starts with “At Storm Peak Laboratory” must be rephrased.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 15641, 2009.

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